Constraint Lattice in Qualitative Simulation

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The main motivation of the Constraint Lattice (CL) is the Arithmetic Reasoning. The complexity of arithmetic Reasoning ranges from simple integer arithmetic to powerful symbolic reasoning. The reasoning is an arithmetic inference combining qualitative and quantitative predicates as well as arithmetic relations. Combining means cooperation of a type of knowledge with any other type.

The main purposes of the CL can be summarized at three points. The first purpose is to enrich the problem with newly created constraints, thus, to make the diagnosis and explanation properties of system more powerful defining more functional relations between variables. The second purpose is to check the correctness of a model and to ensure more effective executions in constraint propagation and simulation phase inserting new constraints, which were neglected or are not estimated by user, to the model creating them automatically. The third purpose is not only to make more effective propagation in qualitative constraints set but also to allow to a qualitative simulator to filter the behaviors generated by the qualitative simulation algorithm in an efficient way.

The system developed in this study consists of three types of knowledge bases. The knowledge bases are related to qualitative values, signs of function and derivation, direction of changes, and special arithmetical properties of the constraints. Each knowledge base has different number of rules. To use the knowledge base that has fewer rules in propagation and in behavior filtering operation speeds up the processes. Any constraint created by CL may require fewer rules than the constraints by which it was spawn require. In the worst case, the computation efforts are not worse than that of the fact that original constraints require.

Constraint Lattice empowers system definition and explanation that is one of the main concerns in qualitative modeling area.

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